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OCT 23 2001

ENERGY FACILITY SITE EVALUATION COUNCIL

October 20, 2001.

Attention: Mr. Allen J. Fiksdal. EFSEC. 925 Plum Street SE, Building 4. Olympia, WA 98504-3172 (360) 956-2121	CC. Governor Gary Locke Office of the Governor PO Box 40002 Olympia, WA 98504-000
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Dear Sir:

I have been following the development of the prospected Sumas Energy Power Plant number 2. I am deeply concerned about locating yet another power plant next to the existing SE-1. The exhaust gas volume from the two plants is horrendous. The technology used is no better than safety equipment installed and the operator on the job like the gas line in Bellingham that blew up. Many people have made Sumas, Everson, Nooksack and the county their home because of the farming and the woods around this area. We out here are not asking to be put in a Class I PSD or Class II PSD zone. If Sumas what the pollutants they can have them but not pass them on to us. Now that we are faced with yet another power plant many are thinking about relocating.

In your "3.1 Air Quality" document there is something missing like specification on the actual Natural Gas that will be used. I have included one test sample from one of my customers. You can see that H₂S is removed. Is the Natural Gas that will be used in Sumas free from H₂S? I know that the wells in Alberta are full of H₂S and cows and people there die if they only get exposed to small dosages. Please take a look at the Natural gas analyses included. As you can see that all most 50% is CO₂ gas and this gas is only a waste product. The CO₂ does not contribute to the combustion process at all, it will actually steal energy and pass it on to the ambient air. There is a lot of small groups of heavier carbon combinations that will not burn up in a gas turbine and will show up as particulate (sot) in the exhaust. The outgoing flue gas temperature is not mentioned at all.

I can only guess that the outgoing exhaust has is about 250 to 350 degree F. If that is the case most of the exhaust gas will spread out as it comes out of the stack and the density will increase. The increased density will increase toxicity and oxygen content will be reduced. Wood waste burners in Alberta run hot and their exhaust gas condensates at 52,000 feet. Private air plain pilots can navigate according to these condensations plumes high up in the sky. My point is that the lower exhaust gas temperature the higher concentration of flue gas in the area near the ground. Sumas mountain and surrounding mountains will hold the exhaust gas in the area for a long time. This will allow the exhaust gas to thicken over a large area and the Oxygen concentration will fall. Sot and other heavier particulate will fall out and all the surrounding areas will be dirty. This problem will be more visible when the SE-2 is on line.

Storage and use of Ammonia is another problem. If there is a leak, the gas will linger around for a long time and react with water suspended in the air from cooling towers and local rainfall. I the old pulp mills that use Ammonia for bleaching (modern plants are using Oxygen) all the employees are equipped with gas masks. Every one driving through Sumas or living there will need one. They will all be in the industrial gas zone that will require a gas mask (guess they don't work

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2

at the plant so who cares?).

Combustion temperature on the gas turbine is high and this will create NOx or also called NO, NO2, NO3 and may be NO4. NO3 is my major concern due to its toxicity that attacks any living thing. You should many be reading up on this gas. NO4 will not probably be produced at the gas turbines regular operating temperature. I have included two articles regarding the usage Ammonia and SCR. I am concerned about operator error of equipment failure because of the very narrow temperature operation window where the SCR can operate (50 to 100 degrees F.). A small change in the demand for power will easily cause the operator to misjudge the situation and dump (spill) Ammonia or NOx out in the air in large quantities. This situation can be ongoing for some time and the concentration of NOx and/or Ammonia will reach levels that will kill people and other life. Nooksack had E. Coli bacteria in the drinking water again. I think it is because of the warm summer we had and the water table in Sumas went down some because of the high water usage at SE-1.

3

I will include some bullet points for an easy evaluation.

1. The flue gas is cool and will linger at lower levels and concentration will increase.
2. Surrounding mountains will hold flue gas captive.
3. Storage and transportation of Ammonia is hazardous. Too close to main traffic and people.
4. Exhaust gas volumes are too large for the surrounding area.
5. The technology used might work for a smaller plant but not for two at the same location because of the compounded risk factor.
6. Water table will go down, ground water will go lower and pesticide from Fraser Valley will come into our drinking water including bacteria from the surface. Do we want another Walkerton Ont. like in Canada and chlorinated water? No!
7. Potential for boiler explosion or turbine rupture is not disused. It will be quite devastating if flying debris from one power plant will hit the other or its power lines.
8. Operator or management error will cost us a lot. Just look at Bellingham and the gas line. Education and responsible people is very important in running a power plant especially when two are competing next to each other.
9. Emissions from SE-1 is not listed in your documentation and we have to rely on the estimates done in your report and the later see how SE-2 will do emission wise. I am just asking, is ES-1 not passing current emission standard? Why can't ES-1 emission test be publicized?
10. SCR technology is widely criticized for being a Engineer gadget that has not left the laboratory yet. SCR technology needs fast acting emission testing equipment that can catch small changes before they get out of control. I know how important that is from garbage incineration. There seems like there is little or no requirements for continuous emission surveillance. I think this is odd because of the impact an error will have on human life and nature in general. It looks like there is some blind trust in SCR.

4

My conclusion is that two plants side by side in Sumas is too risky and too much exhaust gas in an unsuited area. Build the power plant out on the coast at ARCO refinery where it belongs and power is needed in large quantities.

Regards

Rolf B. G. Nilsen

Rolf B. G. Nilsen.

The Columbus Dispatch

AEP backs off plan to use toxic ammonia.

Tuesday, December 19, 2000. Michael Hawthorne, Dispatch Environment Reporter

Responding to complaints from residents and political leaders, American Electric Power is abandoning a potentially hazardous method to clean the exhaust of its massive Gavin plant in southeastern Ohio.

AEP announced yesterday that it won't install six 60,000-gallon tanks to hold toxic anhydrous ammonia at the plant.

Instead, the Columbus-based company plans to use urea, a dry nitrogen fertilizer that will be converted into ammonia before it's injected into the exhaust. The urea is considered safe in storage.

Like other utilities that rely on coal-fueled power, AEP is installing devices to comply with federal regulations that require significant reductions in smog-producing nitrogen oxides, which several studies have linked to asthma and other breathing problems.

Residents of Cheshire, a tiny Ohio River village 86 miles south of Columbus in the Gavin plant's shadow, strongly objected to AEP's original plan. They noted that the village and three nearby schools would have had about six minutes to evacuate if one of the anhydrous ammonia tanks had leaked.

"We took those concerns to heart," said John Norris, AEP senior vice president of operations and technical services.

Opponents of the plan to use the more dangerous form of ammonia welcomed the announcement. "We needed a decision we could live with, and we got it," Cheshire Mayor Tom Reese said.

While tests have shown urea can reduce nitrogen oxides through a process known as selective catalytic reduction, AEP officials said it hasn't been tried at a plant the size of Gavin. The plant's two 1,300-megawatt generators produce enough electricity to power everything within the Outerbelt -- with some to spare. AEP expects to have the new system in place in time for the summer smog season. As many as 15 railcars of urea will be brought in each week, said Tom Holliday, a company spokesman. AEP decided the technology could work after three months of study, though political pressure might have helped the company make its decision to switch to urea.

Reese enlisted other local governments and U.S. Rep. Ted Strickland, D-Lucasville, to draw attention to the potential threat of anhydrous ammonia, a gas that can cause blindness and severe damage to the throat and lungs.

"I do not believe that the village of Cheshire and its neighboring communities should have to live in constant fear for their safety and the safety of their children," Strickland wrote in a letter to E. Linn Draper Jr., AEP chairman. Opponents of AEP's original plan also got a public relations boost when Maryland-based Constellation Power Source Generation decided it would switch to a safer, water-based form of ammonia and, later, to urea.

Residents near one of Constellation's plants had complained about plans to use a more dangerous form of ammonia.

Utilities are installing the pollution controls after a federal appeals court upheld anti-smog regulations proposed by the U.S. Environmental Protection Agency. Ohio and other mid-western states must cut emissions of nitrogen oxides by 80 percent by 2004.

mhawthor@dispatch.com

Selectmen approve smog-busting proposal

SE-2 NO.

By KEVIN DENNEHY
STAFF WRITER

SANDWICH - A Cape Cod Commission subcommittee today will consider whether to approve Southern Energy's proposal to install pollution-control equipment on the existing burners at the Canal Electric plant.

The proposal was approved unanimously last night by the Sandwich Board of Selectmen after a of a sometimes contentious debate. A town-hired consultant made his opinion of Southern's plan clear. Peter Guldberg of Tech Environmental said the technology is the best available plan to reduce nitrogen oxide, a component of smog, considered the biggest emissions problem at the Sandwich plant.

"It represents, in my opinion, an important environmental initiative in this region," Guldberg told a crowd of about 60 people crowded into the meeting room at the town building on Jan Sebastian Drive. The so-called selective catalytic reduction systems, or SCRs, "do represent the best available control technology," he said.

But representatives from the Cape Clean Air Coalition, a group of Upper Cape residents, questioned Guldberg and Southern's project manager, Norm Cowden, about the risks of the plan. Among their concerns were that SCRs do not control all volatile emissions, and that the equipment requires the addition of ammonia, even if it is in the safer, solid form that Southern has promised.

They urged selectmen, and the Cape Cod Commission, to deny Southern's plan until the plant owners commit to retrofit the existing burners to burn natural gas rather than sulfur-based oil and to use pollution-control equipment that does not require ammonia. Prior to their vote, selectmen sought assurances from Southern that the company would stick with the pelletized ammonia system.

Southern Energy wants to add the SCRs to the oil-burning Unit 1 by next summer, and have the second burner equipped the following year.

The equipment would reduce nitrogen oxide emissions by about 2,000 tons, or about 80 percent, during the summer smog season. It would also free Southern from having to pay other plants for emissions credits to which they would otherwise be subject if unable to meet federally capped standards imposed on the Sandwich plant.

This year, Southern had to pay about \$2.5 million in credits to meet federal regulations.

Many residents are concerned that while the technology reduces nitrogen oxide output, it does nothing to reduce sulfur dioxide and particulate emissions. And because the SCR system relies on ammonia, it introduces a new chemical not currently emitted from the plant.

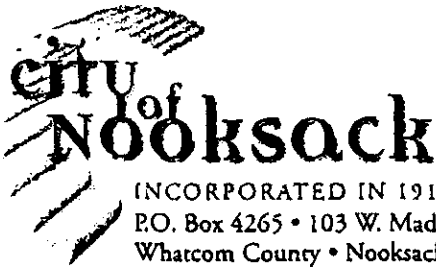
But Bob Gottsche of Sandwich urged selectmen last night to support the plan. He said the town should move forward with emissions reduction, rather than arguing about improved "pie-in-the-sky" technology that may never arrive.

"In the meantime, we have a definite proposal on the table that will benefit the town in many ways," he said.

<http://www.capecodonline.com/cctimes/archives/1999/july/9/nosmog9.htm>

Natural Gas.

	% mol range	
N2	9,084%	3,225%
CO2	45,031%	34,038%
H2S	0,000%	0,000%
CH4 (C1)	41,301%	59,740%
C2H6 (C2)	1,509%	1,150%
C3	1,008%	0,626%
I-C4	0,426%	0,197%
N-C4	0,418%	0,268%
Neo-C5	0,000%	0,000%
I-C5	0,060%	0,108%
N-C5	0,350%	0,166%
C6	0,223%	0,197%
C7	0,060%	0,108%
C8+	0,528%	0,178%
	100,000%	100,000%
LHV (kcal/Nm3)	4.771	5.875
LHV (kcal/Sm3)	4.523	5.569
molecolare weight	31,53	27,04



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NOTICE TO WATER SYSTEM USERS

COLIFORM BACTERIA MAXIMUM CONTAMINANT LEVEL VIOLATION

The City of Nooksack Water System, ID# 59800R in Whatcom County, submitted a coliform bacteria sample on 9/12/01. The test results show that coliform bacteria were present at the time of sampling. On 9/14/01, the City took four repeat samples as required by the United States Environmental Protection Agency (EPA). Again, resulting in coliform bacteria being present. **No E. Coli was present in these samples.**

The EPA sets drinking water standards and has determined that the presence of total coliform is a possible health concern. Total coliforms are common in the environment and are generally not harmful themselves. The presence of this bacteria in drinking water, however, generally is a result of a problem with water treatment or the pipes which distribute the water, and indicates that the water may be contaminated with organisms that can cause disease. Disease symptoms may include diarrhea, cramps, nausea, and possible jaundice, and any associated headaches and fatigue. **These symptoms, however, are not just associated with disease-causing organisms in drinking water, but also may be caused by a number of other factors other than your drinking water.** EPA has set an enforceable drinking water standard for total coliforms to reduce the risk of these adverse health effects. Drinking water, which meets this standard, is usually not associated with a health risk from disease-causing bacteria and should be considered safe.

THE FOLLOWING STEPS HAVE BEEN TAKEN TO CORRECT THE PROBLEM:

The City of Nooksack will chlorinate the system starting 9/17/01 and will do so through 9/27/01.

The City does not feel that our system is contaminated, but the unsatisfactory samples were a result of contamination resulting from the new construction of water lines.

Upon completion of the chlorination, the City will resample and the results will be posted at the following locations and announced on KPUG, KGMI and KIXT radio stations:

1. Cenex Station
2. Dunny's Drive In
3. Starvin Sams
4. U.S. Post Office
5. City Hall

If you have questions, please contact City Hall at 966-2531.

SCR CATALYSTS

BY JOSEPH A. ROSSIN AND HARVEY S. ROSENBERG, GUILD ASSOCIATES, INC.

DUAL FUNCTION CATALYST PROMISES HIGH NO_x REMOVAL WITH ZERO AMMONIA SLIP FOR GAS TURBINE APPLICATIONS

A new dual function ammonia (NH₃) abatement/SCR catalyst employed in an SCR (selective catalytic reduction) process offers a viable option for treating NO_x emissions from gas-fired turbines. The catalyst is able to reduce NO_x levels to less than 2.5 ppm of NO_x reduction while avoiding NH₃ slip. The catalyst has also demonstrated the ability to function over a wide range of process conditions and has demonstrated excellent stability under laboratory conditions employing simulated turbine exhaust. A similar catalyst for use in coal-fired boiler applications is also under development.

DEMAND FOR DUAL FUNCTION

It is expected that about 400,000 MW of new electric generating capacity will be needed in the U.S. by 2020.¹ Because natural gas is a clean fuel, most of this new capacity will be gas fired, and primarily in the form of combined-cycle power plants based on gas turbines. Natural gas fired combined-cycle plants can reduce CO₂ emissions, which are thought to be a significant contributor to global warming, both because of the reduced carbon content of the fuel compared with other fossil fuels, and the increased thermal efficiency of these plants compared with conventional power plants.

Gas turbines typically emit about 25 to 30 ppm NO_x. Modern gas turbines can be designed to yield NO_x emissions of about 9 ppm, but at the expense of reduced thermal efficiency. Current regulations in California require NO_x emission of less than 2.5 ppm from gas turbines. These regulations are being adopted in other regions of the U.S., and this trend is expected to continue. Recent studies indicate that it may be more cost effective to operate gas turbines at higher efficiency and abate the NO_x after combustion.²

For a typical gas turbine to meet the 2.5 ppm NO_x emission regulations, an abatement efficiency of greater than 90 percent is required. The simplest technology available for meeting this requirement is selective catalytic reduction (SCR) using NH₃. For a simple-cycle installation, the catalyst can be located in the

exhaust duct at a point where the gas stream is at the desired temperature. For a combined-cycle installation, the SCR catalyst can be located in the heat recovery steam generator (HRSG), again at a location providing the optimum temperature for the SCR reactions. The SCR process does not require any dampers or ductwork for the catalytic reactor.

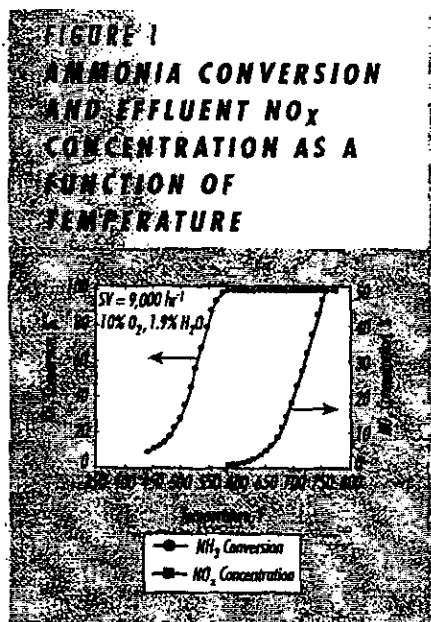
Factors that affect catalyst performance in SCR systems include catalyst composition, operating temperature, space velocity, and molar feed ratio of NH₃ to inlet NO_x.³ Current commercial SCR catalysts employed in coal-fired boilers consist of monolithic honeycomb or plate-type structures with V₂O₅ as the active phase. The optimum operating temperature is about 700 F, and the optimum space velocity (volumetric flow rate at STP of the gas to be treated divided by volume of the catalyst) is between about 3,000 and 10,000 hr⁻¹.

At molar feed ratios of NH₃ to inlet NO_x up to about 0.85, the NO_x removal efficiency follows the stoichiometry for the reaction of NO and NH₃, i.e., 1 mole of NH₃ per mole of NO_x removed. At higher feed ratios, the removal efficiency begins to tail off from the theoretical value. As the molar feed ratio increases above 0.9, the NH₃ slip begins to increase significantly. Operating an SCR catalyst at conditions that allow for a NO_x removal efficiency of 90 percent or greater can result in an intolerable amount of NH₃ emissions.

CATALYST DEVELOPMENT

In attempting to develop a catalyst capable of meeting the stringent California NO_x emission requirements, Guild Associates developed a dual function NH₃ abatement/SCR catalyst that would be able to operate under conditions where high levels of NO_x reduction could be achieved while avoiding NH₃ slip. NH₃ slip would be avoided because the excess NH₃ required for greater than 85 percent NO_x reduction would be decomposed within the catalyst bed.

An alternative strategy would be to place an NH₃ destruction catalyst downstream of an SCR catalyst, thereby allowing for SCR operation at high NO_x removal efficiencies with little or no NH₃



SCR CATALYSTS

slip. However, this scenario would increase the total catalyst cost and increase the pressure drop across the system. Accordingly, Guild Associates opted to develop a dual function catalyst that simultaneously combined NO_x reduction and NH_3 oxidation.

The initial effort aimed at developing an NH_3 destruction catalyst. In the presence of oxygen, NH_3 can be decomposed to yield a variety of reaction products that include H_2O , NO_x , N_2O and N_2 . The objective, therefore, was to identify a catalyst that favored the formation of the reduced products over the formation of the oxidized products. Figure 1 illustrates NH_3 conversion and NO_x concentration in the exhaust gas as a function of temperature

required in order to achieve similar levels of NH_3 destruction. This result indicates that reactions occurring between NH_3 and NO_x are preferred over reactions occurring between NH_3 and O_2 . By itself, the NH_3 destruction catalyst was only able to achieve high levels of NO_x reduction when using large amounts of excess NH_3 .

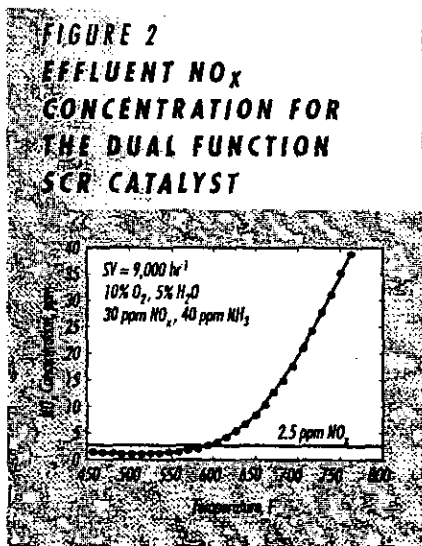
After developing the NH_3 destruction catalyst, the research team next had to incorporate the NH_3 destruction function onto an SCR catalyst. Candidate dual function NH_3 abatement/SCR catalysts were prepared and screened for reactivity in a fixed bed catalytic reactor test stand. Figure 2 presents the effluent NO_x concentration as a function of reaction temperature for one of the dual function NH_3 abatement/SCR catalysts developed during this effort. Results presented in Figure 2 were recorded employing a laboratory scale test stand using simulated turbine exhaust. The monolithic catalyst employed in the testing had a cell density of 100 cells/in². The test was performed by first heating the catalyst to 850 F in a humid flowing oxygen/nitrogen mixture (typically 5 percent H_2O , 10 percent oxygen, and 85 percent nitrogen). Once at temperature, the catalyst was exposed to 30 ppm NO_x and 40 ppm NH_3 at a space velocity of 9,000 hr⁻¹. Once the process stabilized, the catalyst was cooled at the rate of 50 F/hr until NH_3 was detected in the effluent stream. The effluent stream was analyzed for NO_x and N_2O , and the data were used to compare the reactivity and selectivity of different catalyst formulations. N_2O was included in the analysis because it is an important "greenhouse gas" that can be formed during oxidation of NH_3 in the presence of NO .

Decreasing the catalyst temperature from 750 to 600 F resulted in a rapid decrease in the effluent NO_x concentration. Over this temperature range, reactions governing the decomposition of NH_3 are favored over reactions governing the reduction of NO_x with NH_3 . Consequently, the level of NO_x abatement is low. As the reaction temperature is reduced below about 650 F, the NO_x reduction reactions (with NH_3) are favored, and, at temperatures between about 450 and 600 F, effluent NO_x concentrations of less than 2.5 ppm are achieved. The NH_3 slip in the temperature window for less than 2.5 ppm NO_x was <0.25 ppm. The reason for greater than 30 ppm NO_x in the effluent

stream for temperatures greater than about 725 F is that a portion of the NH_3 is converted to NO_x . The N_2O emissions over the optimum temperature window (450 to 600 F) were between 2 and 2.7 ppm. Also, in several tests performed with 200 ppm of CO added to the feed gas, the oxidation of CO to CO_2 was greater than 99 percent.

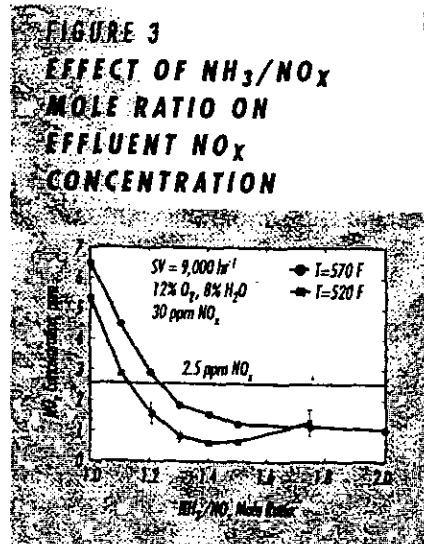
The space velocity employed in the above test (9,000 hr⁻¹) is comparable to space velocities reported for conventional SCR catalysts employed in coal-fired boiler applications, which are between 3,000 and 10,000 hr⁻¹. The dual function NH_3 abatement/SCR catalyst has also been evaluated at much higher space velocities, as high as 18,000 hr⁻¹, where the catalyst's performance decreased. Specifically, the NO_x effluent concentrations increased to between 2.5 and 3.0 ppm, and the effluent NH_3 concentration increased to between 0.75 and 1 ppm.

The effect of the feed NH_3/NO_x mole ratio on catalyst performance was examined at 520 F and 570 F with 24 ppm NO and 6 ppm NO_2 in the feed gas. Figure 3 shows the NO_x concentration in the effluent stream versus the feed NH_3/NO_x mole ratio at the two temperatures for the dual function NH_3 abatement/SCR catalyst. At 520 F, less than 2.5 ppm effluent NO_x was achieved at NH_3/NO_x mole ratios slightly greater than 1.1. At a mole ratio of 1.75, greater than 1 ppm NH_3 was detected in the effluent stream (520 F). At 570 F, less than 2.5 ppm effluent NO_x was achieved at NH_3/NO_x mole ratios slightly greater than 1.2. The effluent NH_3 concentration was <0.25 ppm throughout the 570 F test.

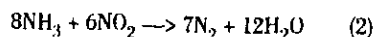
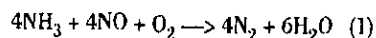


(light-off curve) for a successful NH_3 destruction catalyst. These data were collected using a laboratory scale test stand, with the NH_3 abatement catalyst wash-coated onto a ceramic monolith. There is a about a 50 F temperature window in which there is greater than 99 percent conversion of NH_3 with <3 ppm NO_x in the exhaust gas. Typical SCR catalysts can oxidize NH_3 at higher temperatures than optimum for the reduction of NO_x , but about 50 percent of the NH_3 is converted to NO_x .

It should be noted that the data reported in Figure 1 correspond to NH_3 as a pure component; i.e., there is no NO_x present in the feed gas. Although not shown, the addition of NO_x to the NH_3 -laden feed stream shifts the position of the light-off curve about 30 F to the left, meaning that lower temperatures are now



⁹ It is interesting to compare the above NH_3/NO_x mole ratio results with the stoichiometry of the SCR reactions for the reduction of NO and NO_2 . These reactions are:⁴



For exhaust gas containing 24 ppm NO and 6 ppm NO_2 , the theoretical NH_3/NO_x mole ratio for complete destruction of the NO_x is 1.07 $[(24/30 \times 1.00) + (6/30 \times 1.33) = 1.07]$. The laboratory experiments yielded greater than 90 percent NO_x reduction at an NH_3/NO_x mole ratio of 1.1 at 520 F and 1.2 at 570 F. This result indicates that only a slight excess amount of NH_3 is required.

STABLE AND ROBUST

Stability is always an important issue in selecting catalysts for NO_x abatement. The dual function NH_3 abatement/SCR catalyst described above has been tested for several hundred hours of continuous operation using simulated gas turbine exhaust with no observed deactivation. For conventional SCR catalysts employed in coal-fired boiler applications, known deactivation mechanisms include fouling caused by deposition of fly ash, poisoning resulting from impurities in the process stream (e.g. alkali or alkaline earth oxides, arsenic compounds), and thermal processes leading to a reduction in the titania surface area.^{5,6} For gas-fired turbine applications, many of the deactivation mechanisms associated with conventional SCR catalysts can be eliminated due to the "cleaner" nature of the emission source. Therefore, it is anticipated that the dual function NH_3 abatement/SCR catalyst will have a long operational lifetime.

In addition to near zero NH_3 slip, the dual function NH_3 abatement/SCR catalyst has several other advantages over conventional SCR catalysts. First, the catalyst can operate at lower temperatures (between 500 and 600 F, Figure 2), which is expected to enhance the catalyst stability, since deactivation due to thermal processes will be minimized. Second, the dual function NH_3 abatement/SCR catalyst has a temperature window of greater than 100 F for achieving less than 2.5 ppm NO_x emissions while avoiding NH_3 slip. The wide operating window will minimize catalyst performance effects associated with changes in temperature resulting from changes in the turbine

load. Third, the process can operate over a range of NH_3/NO_x mole ratios, thus making it easier for the process to respond to transient conditions.

The next step in the catalyst development/commercialization effort for gas turbine applications will be to evaluate the catalyst performance employing actual gas turbine exhaust.

Guild Associates is also attempting to develop a similar catalyst to treat NO_x emissions from coal-fired boilers. For coal-fired boilers, the problem of NH_3 slip takes on an added dimension because the NH_3 can react with SO_2 to produce salts that deposit on the air heater, which is downstream of the SCR reactor. Also, any NH_3 slip can be adsorbed by the fly ash, result-

ing in a material that is difficult to market or dispose. In retrofit installations, major

modifications may have to be made to the air heater to minimize fouling and corrosion problems associated with salt deposition.

Some important considerations with regard to SCR installations on coal-fired boilers are poisoning of the catalyst by SO_2 or other components in the flue gas, e.g. arsenic, and catalytic oxidation of SO_2 to SO_3 . Dual function catalysts, therefore, must include formulations that are resistant to poisoning by

SO_2 . Furthermore, if conventional SCR catalysts can overcome the arsenic poisoning problem, dual function catalysts should be able to as well. \square

IT MAY BE MORE COST EFFECTIVE TO OPERATE GAS TURBINES AT HIGHER EFFICIENCY AND ABATE THE NO_x AFTER COMBUSTION.

Authors—

Dr. Joseph A. Rossin is Head of Catalyst Applications at Guild Associates, where he has worked since 1994. He has 15 years' experience in catalysis and reaction engineering. Rossin received his Ph.D. in chemical engineering from Virginia Polytechnic Institute and State University in 1986.

Dr. Harvey S. Rosenberg heads Guild's stack gas emissions control group. He has worked extensively in the areas of radioisotope applications, nuclear reactor safety, coal utilization and conversion technology, and NO_x abatement. Rosenberg received his Ph.D. in chemical engineering from Ohio State University in 1973 after receiving his B.S. in chemical engineering from Cooper Union School of Engineering in 1959.

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Acknowledgements:

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